EPA United States Environmental Protection Agency
Solid Waste and Emergency Response (5306W)
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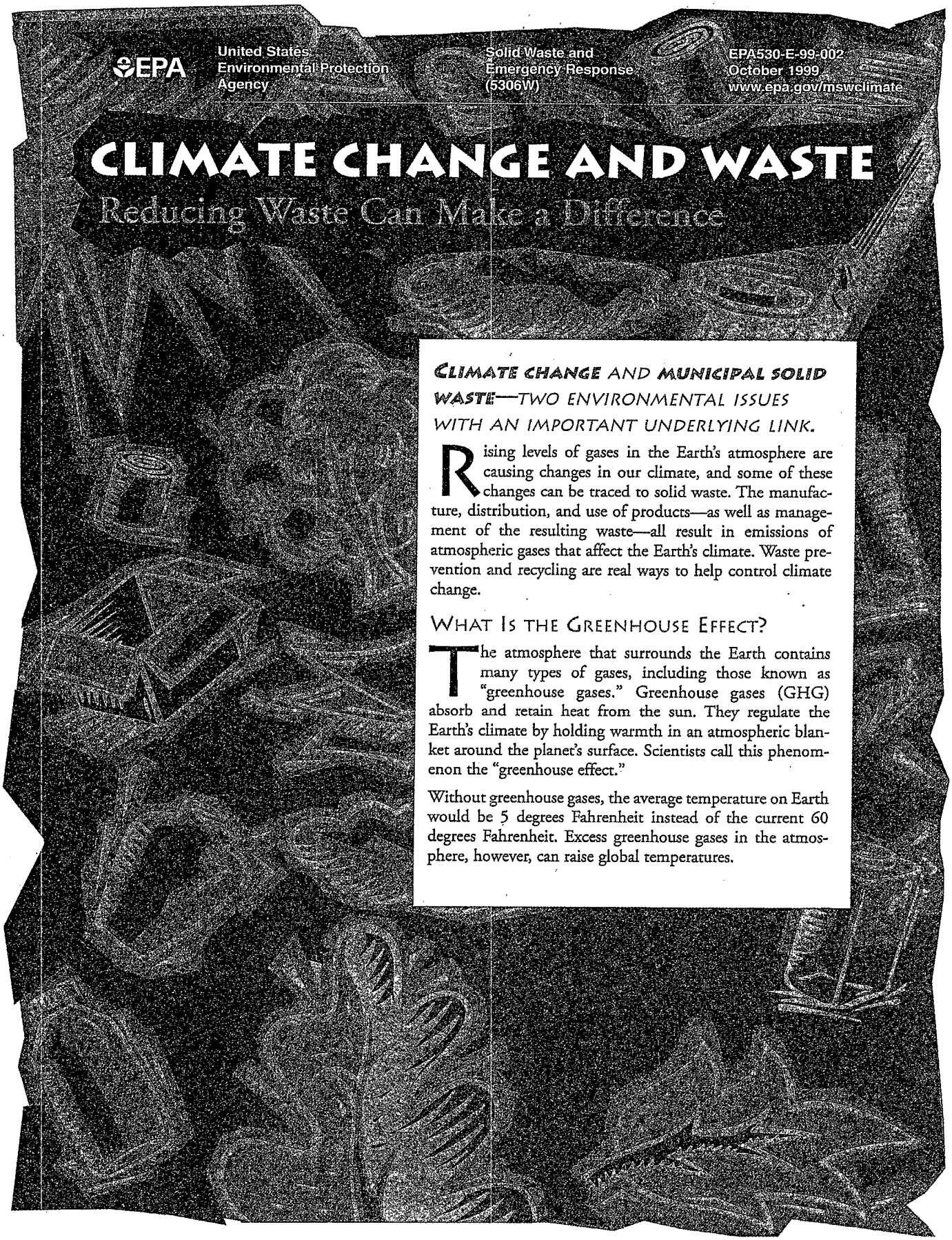
www.epa.gov/mswclimate

CLIMATE CHANGE AND WASTE

Reducing Waste Can Make a Difference



CLIMATE CHANGE AND MUNICIPAL SOLID WASTE—TWO ENVIRONMENTAL ISSUES WITH AN IMPORTANT UNDERLYING LINK.

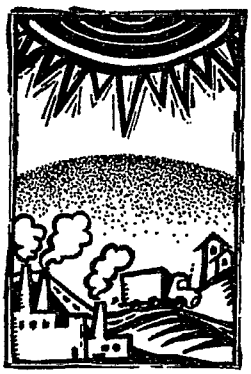
Rising levels of gases in the Earth's atmosphere are causing changes in our climate, and some of these changes can be traced to solid waste. The manufacture, distribution, and use of products—as well as management of the resulting waste—all result in emissions of atmospheric gases that affect the Earth's climate. Waste prevention and recycling are real ways to help control climate change.

What Is the Greenhouse Effect?

The atmosphere that surrounds the Earth contains many types of gases, including those known as "greenhouse gases." Greenhouse gases (GHG) absorb and retain heat from the sun. They regulate the Earth's climate by holding warmth in an atmospheric blanket around the planet's surface. Scientists call this phenomenon the "greenhouse effect."

Without greenhouse gases, the average temperature on Earth would be 5 degrees Fahrenheit instead of the current 60 degrees Fahrenheit. Excess greenhouse gases in the atmosphere, however, can raise global temperatures.

1. *The Earth's atmosphere contains greenhouse gases that hold the sun's warmth. In this way, greenhouse gases help control global temperatures.*



2. *Certain human activities release additional greenhouse gases, upsetting the natural atmospheric balance. Increasing the concentration of greenhouse gases raises global temperatures.*

What Are the Consequences of Climate Change?

What's so bad about warm days and balmy nights? Why try to reduce greenhouse gas emissions? Unfortunately, increased concentrations of greenhouse gases in the atmosphere will not create a worldwide tropical paradise. Even if it did, the Earth's diverse ecosystems depend on a variety of climates. Human activities that thicken the gaseous "greenhouse" around the planet threaten to disrupt the diversity of habitats and the life dependent on them.

In the past 100 years, scientists have detected an increase of 1 degree Fahrenheit in the Earth's average surface temperature. The international scientific community is increasingly agreed that human activity is responsible for some of this increase. A rise of only a few degrees in the Earth's average temperature could result in:

- More frequent and intense storms
- Flooding of beaches, bay marshes, and other low-lying coastal areas
- More precipitation in some areas and not enough in others
- Wider distribution of certain infectious diseases

Such significant changes could damage communities and national economies as well as alter the natural world. Of course, many uncertainties remain. No one can predict the precise timing, magnitude, and regional patterns of climate change. Nor can anyone foretell the ability of mankind and nature to adapt to such changes.

It is clear, however, that climate change will not be easily reversed. Because greenhouse gases remain in the atmosphere a long time, turning back climate change may take decades or even centuries.

Just as a heavy coat holds in your body heat on a winter day, greenhouse gases retain the Earth's heat. Imagine, though, if you couldn't take off your parka in August.

What Is the Link Between Solid Waste and Climate Change?

Waste prevention and recycling—jointly referred to as waste reduction—help us better manage the solid waste we generate. But preventing waste and recycling also are potent strategies for reducing greenhouse gases. Together, waste prevention and recycling:

- **Reduce emissions from energy consumption.** Recycling saves energy. Manufacturing goods from recycled materials typically requires less energy than producing goods from virgin materials. Waste prevention is even more effective. When people reuse things or when products are made with less material, less energy is needed to extract, transport, and process raw materials and to manufacture products. The payoff? When energy demand decreases, fewer fossil fuels are burned and less carbon dioxide is emitted to the atmosphere.
- **Reduce emissions from incinerators.** Recycling and waste prevention allow some materials to be diverted from incinerators and thus reduce greenhouse gas emissions from the combustion of waste.
- **Reduce methane emissions from landfills.** Waste prevention and recycling (including composting) divert organic wastes from landfills, reducing the methane released when these materials decompose.
- **Increase storage of carbon in trees.** Trees absorb carbon dioxide from the atmosphere and store it in wood, in a process called "carbon sequestration." Waste prevention and recycling of paper products allow more trees to remain standing in the forest, where they can continue to remove carbon dioxide from the atmosphere.

What Are Greenhouse Gases?

Some greenhouse gases occur naturally in the atmosphere, while others result from human activities.

Naturally occurring greenhouse gases include water vapor, carbon dioxide, methane, nitrous oxide, and ozone. Certain human activities, however, add to the levels of most of these naturally occurring gases.

Carbon dioxide is released to the atmosphere when solid waste, fossil fuels (oil, natural gas, and coal), and wood and wood products are burned.

Methane is emitted during the production and transport of coal, natural gas, and oil; the decomposition of organic wastes in municipal solid waste landfills; and the raising of livestock.

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Pay-As-You-Throw
A Cooling Effect on Climate Change

Pay-As-You-Throw (PAYT) is a program that encourages residents to reduce the amount of waste they generate and to recycle more. The benefits of this program go beyond the obvious advantages of generating less waste. The manufacture and distribution of products and the subsequent management of municipal solid waste (MSW) contribute to the formation of greenhouse gases. To lower greenhouse gas emissions from these actions, as well as for other environmental benefits, EPA is encouraging waste prevention and recycling (jointly referred to as waste reduction) through the PAYT Outreach Initiative.

What Is PAYT?

PAYT programs break with tradition by ensuring that households see and feel the cost of waste disposal services. Under a traditional system, residents pay indirectly for these services through their property taxes or through a flat fee. With PAYT, residents pay directly for trash services based on the amount of waste they throw away—similar to the way they pay for electricity, gas, and other utilities.

When consumers pay for every bag or can of waste they generate, they are motivated to recycle more and look for creative ways to prevent waste in the first place. In communities that implement PAYT, overall waste disposal can decline by 14 to 27 percent on average. In addition, recycling rates often increase dramatically in these communities, sometimes reaching double or even triple what they had been before the program was implemented.

Some residents in PAYT communities change their behavior in other significant ways. While shopping, they are more likely to purchase items in bulk and to select products with the least amount of unnecessary packaging. Rather than throw items away, a PAYT household is likely to look first for ways to reuse these goods or to give them away, as charitable donations, for example. Rather than bag yard trimmings and leaves, households might choose instead to compost these materials in their backyards.

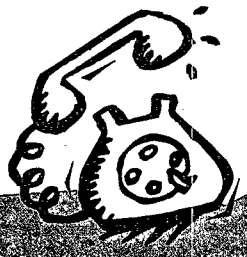
How Does PAYT Help Reduce Greenhouse Gas Emissions?

PAYT programs are based on a simple premise: trash services are not free. One important cost of solid waste, in addition to its other environmental effects, is climate change. Whenever products are made, distributed, and disposed of, greenhouse gases are released and contribute to climate change. Community PAYT programs—which spur residents to prevent and recycle more waste—can reduce greenhouse gas emissions significantly.

When we reduce, reuse, and recycle products, we decrease the greenhouse gas emissions associated with making, distributing, and disposing of these products. For example, when we buy in bulk, we purchase less packaging. That means lower energy requirements for manufacturing. It means less waste that

might create methane emissions in landfills, and, if paper products are at issue, it means more trees standing in the forest to absorb greenhouse gases from the atmosphere.

Is it possible to measure the climate change benefits of PAYT? Yes! To help quantify the climate change benefits of waste reduction programs such as PAYT, EPA conducted a comprehensive study of the relationship between solid waste management and climate change. The study estimated the greenhouse gas emissions associated with managing major commodity types in the MSW stream. The study resulted in the development of greenhouse gas emission factors that can be used to calculate the climate change benefits of various waste management practices.



For more information on climate change and waste reduction, including EPA's study on greenhouse gases and waste management, access EPA's Web site at <www.epa.gov/mswclimate>. To order EPA's tool kit for planners interested in implementing PAYT, as well as a video, fact sheets, guidebooks, and other materials, call the PAYT Helpline toll free at 888-EPA-PAYT. Or find it all online at <www.epa.gov/payt>.

To analyze the specific climate change benefits of PAYT programs, EPA used these greenhouse gas emission factors in combination with the results of a PAYT study conducted by researchers at Duke University. The Duke study analyzed program statistics from 212 PAYT communities across the country and calculated the average amount of per capita waste reduction experienced by these communities. EPA then calculated the per capita climate change impact of PAYT using this average PAYT waste reduction percentage and the greenhouse gas emission factors.

EPA estimates that for each person participating in a PAYT program, greenhouse gas emissions are reduced by an average of 0.088 metric tons of carbon equivalent (MTCE, the basic unit of measure for greenhouse gases). This means that a community of 100,000 people could potentially reduce greenhouse gas emissions by 8,800 MTCE by implementing a PAYT program. This calculation is based on the assumption that residents in PAYT communities recycle a mix of the most common recyclable materials (e.g., plastic bottles, newspapers, steel and aluminum cans).

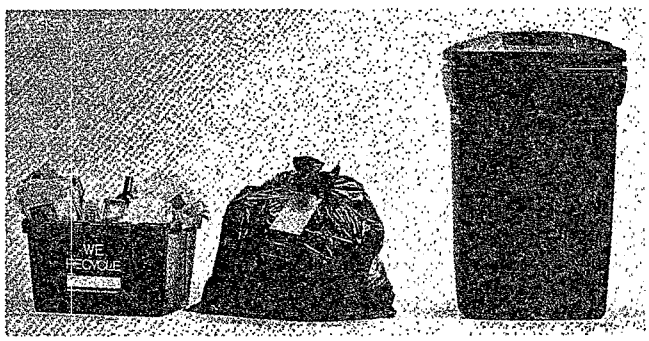
How Can I Measure Greenhouse Gas Emission Reductions?

Along with the more obvious recycling and waste prevention impacts of PAYT, measuring its climate change benefits can help describe a program's full environmental advantages to elected officials, residents, and other stakeholders. Also, waste reduction programs such as PAYT can play an integral part in a community's climate change action plan. Here's how you can calculate the potential climate change benefits of your PAYT program:

Use the National Average. If you wish to use the national average for greenhouse gas reductions, you can multiply the number of program participants by 0.088 MTCE as illustrated in the example above. The resulting number is the estimated average annual reduction in greenhouse gases for your program.

Use Local Data. If you wish to obtain an estimate tailored to your community's specific PAYT program, you can apply your own data by using EPA's WAste Reduction Model (WARM). This easy-to-use spreadsheet applies the same greenhouse gas emission factors mentioned above to your community's specific waste management situation. Please note that in order to use WARM, you will need to have data on the amount of waste your community generated and reduced both before and after PAYT was implemented. WARM is available on EPA's Climate Change and Waste Web site at <www.epa.gov/mswclimate>.

Should your community consider PAYT? If your community's planners are looking for ways to get residents to put more recyclables out at the curb and generate less trash, then the answer is probably yes. The additional climate change benefits enjoyed by PAYT communities show that it can be an environmentally sustainable way to manage our nation's solid waste.



Pay-as-you-throw gives individuals an incentive to generate less trash and recycle more.

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WasteWise: Climate Benefits From Reducing Waste

WasteWise, a program that promotes waste prevention and recycling practices—jointly referred to as waste reduction—in offices and industry, diverts materials from the municipal solid waste stream. In addition to cost savings and efficiencies, waste reduction has positive effects on climate change. The manufacture and distribution of products and the subsequent management of solid waste can contribute to the formation of greenhouse gases. To lower greenhouse gas emissions from these actions, as well as for other environmental benefits, EPA is encouraging waste reduction efforts through its WasteWise program.

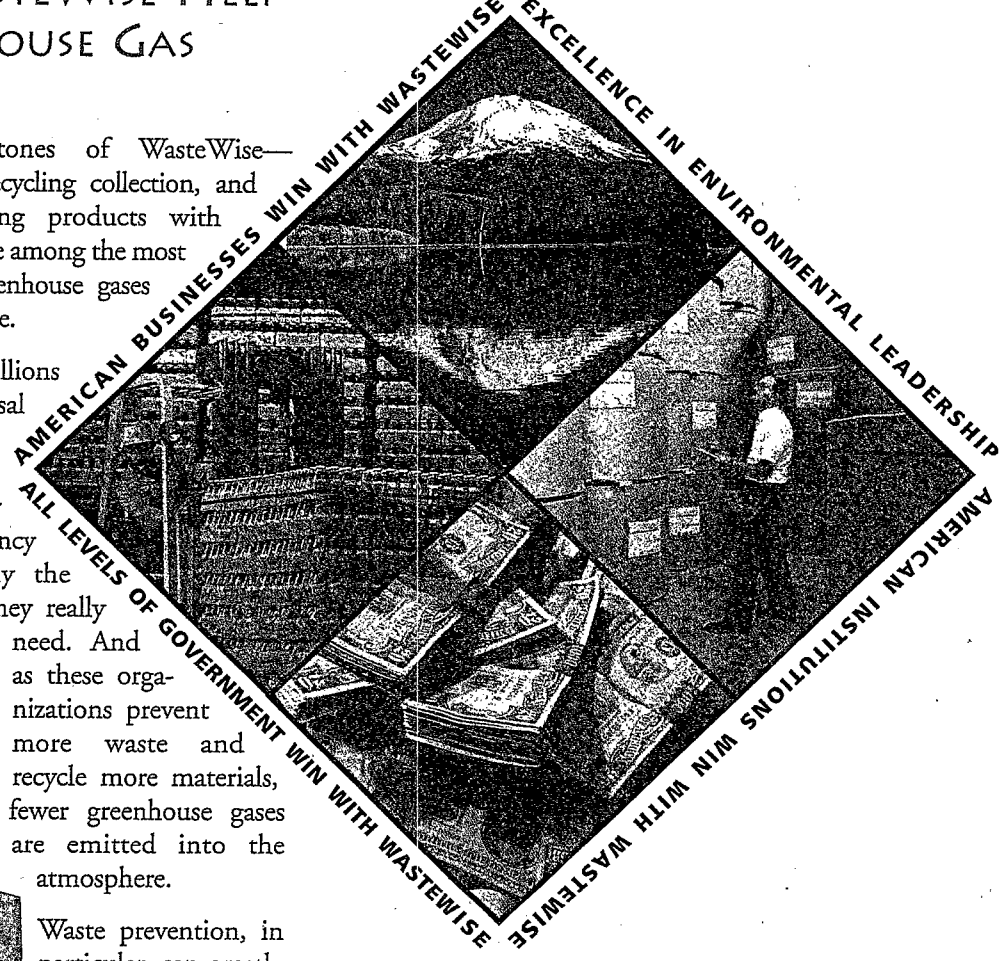
What Is WasteWise?

Since January 1994, EPA has been working in partnership with American businesses; federal, state, local, and tribal governments; and institutions to reduce municipal solid waste. Presently, more than 950 organizations are WasteWise partners. Partners are located all across the country and represent a variety of business, civic, and industrial sectors, ranging from small local governments to Fortune 1000 corporations. Through the WasteWise program, partners make a voluntary commitment to implement or expand a solid waste reduction program with three complementary components:

- **Preventing waste.** The cornerstone of WasteWise is waste prevention, which means using less material to do the same job or produce the same product. WasteWise partners commit to implementing three significant waste prevention activities of their choice.
- **Recycling collection.** By collecting recyclables, WasteWise partners divert materials from disposal. They commit to initiate, expand, or improve internal programs to collect recyclables. For example, offices may add new materials to an existing program or boost recycling rates by educating employees or the community.
- **Buying or manufacturing recycled-content products.** WasteWise partners can play a key role in integrating recycled-content materials into consumer markets. They commit to purchasing products with recycled content. Manufacturers may also raise the percentage of postconsumer materials in the products they make.

WasteWise partners design their own solid waste reduction programs, tailored to meet their needs and operations. Partners monitor their progress during a 3-year period and report annually to EPA on their accomplishments. The WasteWise program helps participating organizations discover waste reduction opportunities and set waste reduction goals. Partners have access (through a toll-free helpline) to WasteWise representatives, who provide personalized assistance, and to a wide range of waste reduction publications and electronic support services. EPA also publicly recognizes individual organizations and program successes.

How Does WasteWise Help Reduce Greenhouse Gas Emissions?



The three cornerstones of WasteWise—waste prevention, recycling collection, and buying/manufacturing products with recycled content—are among the most effective ways to slash the greenhouse gases traceable to municipal solid waste.

WasteWise partners divert millions of tons of material from disposal each year. They also attain higher levels of efficiency by using only the materials they really need. And as these organizations prevent more waste and recycle more materials, fewer greenhouse gases are emitted into the atmosphere.

For more information on WasteWise, call the WasteWise helpline at 1 800 EPA-WISE (372-9473) or go to <www.epa.gov/wastewise>. For more information on climate change, including how to estimate greenhouse gas (GHG) emissions from solid waste management activities using EPA's WAste Reduction Model (WARM), you can access EPA's Climate Change and Waste Web site at <www.epa.gov/mswclimate>.

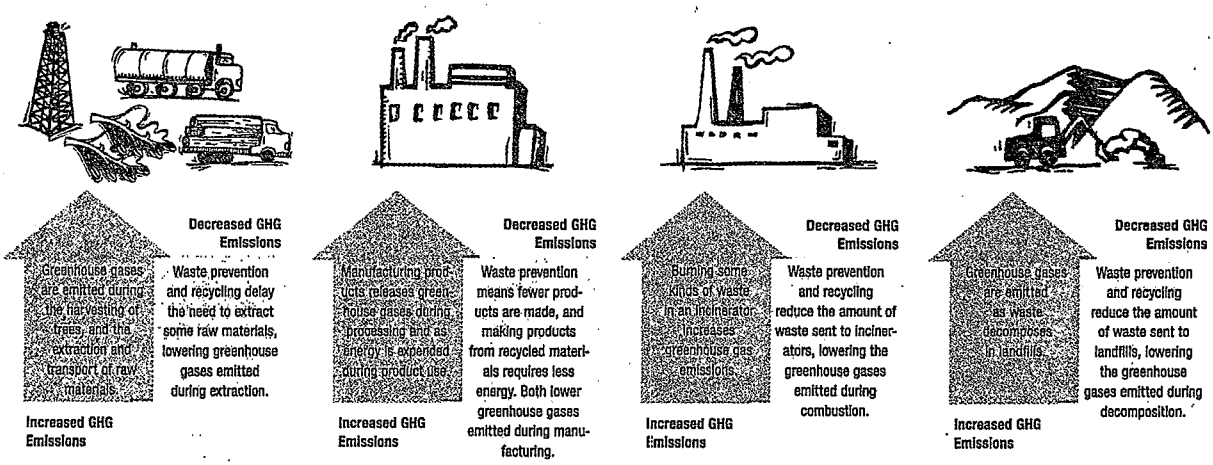
Waste prevention, in particular, can greatly reduce the emission of greenhouse gases by conserving raw materials and the energy expended to retrieve, process, and manufacture them into products. In addition, waste prevention keeps materials out of landfills and incinerators. Certain materials generate greenhouse gases as they degrade in landfills or burn in incinerators. Overall, waste prevention provides more climate change benefits than any other waste management option.

By boosting their recycling collection efforts, WasteWise partners keep valuable materials out of landfills and incinerators. In particular, many organizations have increased their recycling of office paper and corrugated containers. Keeping paper products out of landfills cuts methane emissions. Recycling used paper saves energy and can leave more trees standing in the forest. Trees take large amounts of carbon dioxide out of the atmosphere and store it in wood.

WasteWise partners are also encouraged to manufacture or buy products made from recyclable materials. This helps ensure that recyclables, rather than raw materials, are used in manufacturing processes. Typically, manufacturing products from recycled rather than virgin materials consumes less energy.

How much of an impact is WasteWise having on climate change? In 1998, WasteWise partners documented some 611,000 tons of waste material reduced, including corrugated cardboard, wood, metal, and paper. They also recycled over 7.2 million tons of waste, including steel, wood, paper, cardboard, and other items. In climate change terms, this is having a tremendous impact. The combined recycling and waste prevention efforts of the WasteWise partners in 1998 alone prevented 7 million metric tons of carbon equivalent (MTCE, the basic unit of measure for greenhouse gases) that would otherwise have been released into the atmosphere. That's like preventing the average annual emissions from electric power consumption of roughly 4.2 million households.

The Link Between Waste Management and Greenhouse Gases



The Balance Sheet: Measuring the Climate Change Benefits of Waste Reduction

To help measure the climate change benefits of waste reduction, EPA conducted a comprehensive study of greenhouse gas emissions and waste management. The study estimated the greenhouse gas emissions associated with managing 10 types of waste materials: office paper, newspaper, corrugated cardboard, aluminum, steel, plastic (HDPE, LDPE, and PET), food scraps, and yard trimmings. Management options analyzed in the study included waste prevention, recycling, composting, incineration, and landfilling.

The research indicates that, in terms of climate benefits, waste prevention is generally the best management option. Recycling is the next best approach. The research enables waste managers to analyze their potential to reduce GHG emissions based on the characteristics of their community's waste stream and the management options available to them.

Waste prevention can make an important difference in reducing emissions. By cutting the amount of waste we generate back to 1990 levels, we could reduce greenhouse gas emissions by 11.6 million metric tons of carbon equivalent (MTCE), the basic unit of measure for greenhouse gases. EPA estimates that increasing our national recycling rate from its current level of 28 percent to 35 percent would reduce greenhouse gas emissions by another 9.8 million, compared to landfilling the same material. Together, these levels of waste prevention and recycling would slash emissions by more than 21.4 million MTCE—an amount equal to the average annual emissions from the electricity consumption of roughly 11 million households.

Every little bit helps! For example, by recycling all of its paper, plastic, and corrugated waste generated in one year, an office building of 7,000 workers could reduce greenhouse gas emissions by 1200 MTCE. This is equivalent to taking about 900 cars off the road that year. If just one household generated 5 percent less waste including newspapers, aluminum and steel cans, and plastic containers and then recycled what remained, 309 pounds of carbon equivalent could be reduced.

How Are EPA's Waste Reduction Programs Helping Reduce the Effects of Climate Change?

The United States is committed to reducing greenhouse gas emissions. In 1992, the United States joined 160 other countries as a signatory to the United Nations (UN) Framework Convention on Climate Change, which calls on countries to reduce their greenhouse gas emissions. Since 1994, the United States has been implementing the Climate Change Action Plan (CCAP), a blueprint for achieving voluntary reductions in greenhouse gas emissions from all sectors of our economy. The CCAP contains some 50 separate initiatives, including one that aims to reduce greenhouse gas emissions through waste reduction and recycling.

Nitrous oxide is emitted during agricultural and industrial activities, as well as during the combustion of solid waste and fossil fuels.

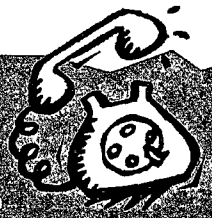
Greenhouse gases that are not naturally occurring include byproducts of foam production, refrigeration, and air-conditioning that are called **chlorofluorocarbons** (CFCs), as well as **hydrofluorocarbons** (HFCs) and **perfluorocarbons** (PFCs) generated by industrial processes.

Each greenhouse gas differs in its ability to trap heat in the atmosphere. HFCs and PFCs are the most heat absorbent. Methane traps over 21 times more heat than carbon dioxide, and nitrous oxide absorbs 310 times more than carbon dioxide.

In 1997 in Kyoto, Japan, the Parties to the UN Framework Convention on Climate Change agreed to a historic protocol on climate change. The "Kyoto Protocol" sets binding targets and timetables for emissions reductions and encourages the use of market-based measures to meet those targets. The specific limits vary from country to country but are similar for Europe, Japan, and the United States. The U.S. target is 7 percent below 1990 emissions over a 5-year period spanning 2008 to 2012. A follow-up meeting of the Parties in Buenos Aires in 1998 focused on setting deadlines and developing a workplan for meeting the targets. On November 12, 1998, the United States signed the protocol, but ratification will require the advice and consent of the Senate. In addition, Congress has mandated that the U.S. Global Change Research Program assess the potential consequences of climate change on the nation. The national assessment began in 1997, and the initial Synthesis Report of the findings is expected to be published in 2000.

Waste prevention and recycling can make a significant contribution to reducing our nation's greenhouse gas emissions. At least 5 percent of the total reductions called for in the CCAP are expected from waste reduction and recycling. To help achieve these reductions, EPA supports a number of programs, including:

- **WasteWise.** WasteWise is a voluntary partnership between EPA and U.S. businesses, state and local governments, and institutions to prevent waste, recycle, and buy and manufacture products made with recycled materials. Presently, more than 900 organizations are participating in the WasteWise program.
- **Pay-As-You-Throw Programs.** EPA provides technical and outreach assistance to encourage communities to implement pay-as-you-throw systems for managing solid waste. Under pay-as-you-throw, residents are charged based on the amount of trash they discard. This creates an incentive for them to generate less trash and recycle more. Currently, there are over 4,000 pay-as-you-throw communities in the U.S. On average, communities with pay-as-you-throw see waste reductions of 14 to 27 percent.
- **Waste Reduction Demonstrations.** EPA has funded more than 30 projects that demonstrate innovative waste reduction approaches with the potential to achieve significant reductions of greenhouse gas emissions.

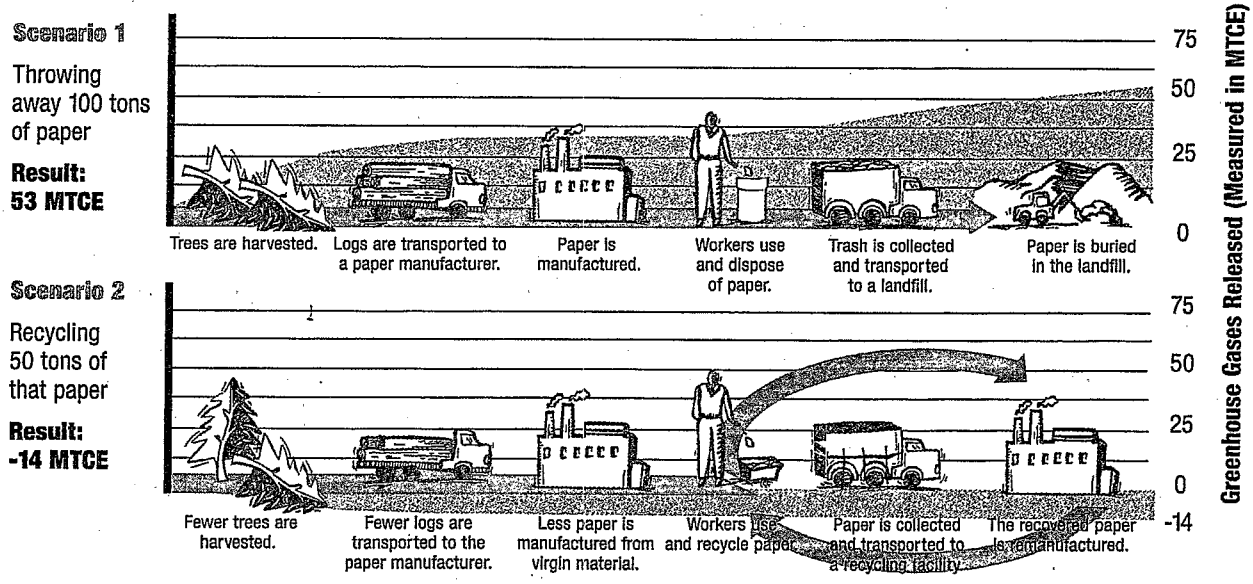


For More Information

For an online copy of EPA's report "Greenhouse Gas Emissions from Management of Selected Materials in Municipal Solid Waste" (EPA 530-R-98-013) and for additional educational materials on climate change and waste, access <www.epa.gov/mswclimate>. EPA's Landfill Methane Outreach Program (LMOP) also demonstrates how to put waste to good use. As waste in landfills decomposes, it produces methane gas, which contributes to global warming. LMOP shows companies, utilities, and communities how to capture landfill gas and convert it to energy. Access the LMOP Web site at <www.epa.gov/outreach/lmop/>.

You Can Make a Difference!

By choosing to prevent waste and recycle, you can help curb climate change. Assume your office, for example, throws away 100 tons of white office paper each year. If you recycle just half that amount of paper, look what happens:



"GREENHOUSE GASES ARE ESSENTIALLY A SUSTAINABILITY ISSUE. AND IF WE WANT TO MOVE TOWARD BEING SUSTAINABLE, WHICH MEANS NOT PASSING OUR COSTS ONTO FUTURE GENERATIONS, WE MUST INCLUDE WASTE REDUCTION AND RECYCLING."

ZACK HANSEN
ENVIRONMENTAL HEALTH SECTION MANAGER
ST. PAUL–RAMSEY COUNTY DEPARTMENT OF PUBLIC HEALTH (MN)

"SOURCE REDUCTION AND RECYCLING HAVE BEEN LONG ACKNOWLEDGED FOR THEIR RESOURCE CONSERVING EFFECTS. NOW THAT WE CAN DEMONSTRATE THEIR LINK TO CLIMATE CHANGE AND THE REDUCTION OF GREENHOUSE GAS EMISSIONS, WE HAVE BROADENED THE SCOPE OF LONG TERM BENEFITS THAT COME FROM WISE MATERIALS MANAGEMENT."

WILLIAM M. FERRETTI
EXECUTIVE DIRECTOR
NATIONAL RECYCLING COALITION

"REDUCING GREENHOUSE GAS EMISSIONS IS THE KEY THAT LINKS ALL OUR STRATEGIC PLAN ENVIRONMENTAL GOALS TOGETHER. WE WILL GET THESE REDUCTIONS BY ENCOURAGING NO-REGRETS OPTIONS WITH NEW TECHNOLOGIES, ENERGY EFFICIENCY, RECYCLING, POLLUTION PREVENTION, AND OPEN SPACE PRESERVATION. THESE INITIATIVES WILL HELP US MEET ALL OUR ENVIRONMENTAL IMPROVEMENT GOALS. REDUCING AIR EMISSIONS AND GREENHOUSE GASES IS AS NECESSARY AS PUTTING RECYCLABLES AT THE CURB."

BOB SHINN
COMMISSIONER
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

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Environmental Protection Agency
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